THE NEW
Essential
Illustrated
Handbook
on Horology

WATCH REPAIR for Beginners

Esmond Stanley

Learn
the Basics
of Watch
and Clock
Repairing

2022 EDITION

WATCH REPAIR FOR BEGINNERS

The New Essential Illustrated Handbook on Horology to Learn the Basics of Watch and Clock Repairing

Esmond Stanley

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Introduction

"What time is it?" Since the dawn of recorded history, the concept of time has perplexed intellects. Several astronomers, mathematicians, physicists, and philosophers have studied time and numerous advanced ideas while developing systems that have aided humanity.

Some philosophical ideas about time were introduced to the world in 1687 by Sir Isaac Newton's "Principia," and they are still recognized today. Today, physics and mechanics are still taught in schools worldwide using these concepts.

According to Newton, time is absolute and unrelated to bodies or their movements. It is imagined as limitless, continuous, immutable in the arrangement of its constituent elements, and infinitely divisible. Time is independent of substance. Time and space would endure even after the cosmos was destroyed.

However, Dr. Albert Einstein developed a new concept of time. According to Einstein, time is relative. It cannot exist unless it is connected to space. In addition, time is added to the three dimensions of length, width, and height that make up objects in space, giving them all four dimensions.

Assume we are in the capital building in Washington at midnight today. The location will be different when I return at noon the next day. The sun has circled the Milky Way, the earth has spun on its axis, and the earth has circled the sun to the east. As a result, once a certain amount of time has passed, we cannot return to the same given space. As another example, suppose the observer was located on Mars or Venus. Time would be measured differently.

According to Einstein, an item's size, form, and visual space are all determined by the velocity of the object or the time it takes the observer to move a specific distance relative to the object. As a result, space cannot be defined by time. We now claim that time is the fourth dimension and that our planet has four dimensions.

Scientists have given us two completely different ideas about time.

We, horologists, will leave it to the scientists to discuss it among themselves. It is in our best interests to determine the mean solar time when setting our clocks and watches. We can confidently assert that man has devised a method to regulate his daily activities by successively dividing the earth's rotation on its axis concerning the sun into days, hours, minutes, and seconds. We'll now consider how time is measured.

An Informative History of Watches

Watches have been around for centuries, but do you know the overall history of watches? Have you ever wondered about the invention of the watch and how they are made? Watches are no longer what they once were. Consider a smartphone, for example. We know it can make calls, send texts, and track fitness data, among other things. In this day and age of cutting-edge technology, it's fascinating to look back in time to see how watches came to be.

Before discussing watches and their origins, it is necessary to discuss the evolution of timekeeping devices. Although early civilizations used simple timepieces such as sundials, the English invented the clock in 1275. Because they were so primitive at first, all they could do was ring a bell once an hour. Engineers and blacksmiths worked together for hundreds of years to create clocks similar to the mechanical clocks we use today. Furthermore, they began experimenting with metals other than steel. Brass, bronze, and silver were among the metals used.

The 19th century was the start of the industrial revolution, which brought significant advancements in every industry. The most important improvements were mass manufacturing, better products, and reduced prices. One of the sectors affected by this productivity boom was the pocket watch industry, and these products finally reached the mainstream market. Previously, only the affluent could buy such expensive and opulent watches. Now even ordinary people can afford them.

Even though wristwatches had been around for a long time, they were rarely worn; wealthy ladies mostly wore them. This occurred because all timepieces were initially too expensive for the average person to

afford due to the perception that watches were a woman's accessory and that few women wore them; relatively few people continued to wear them even after prices began to fall. When men in the military started to wear wristwatches, this pattern shifted. Constant Girard wanted to give his German navy commanders wristwatches in 1880. It gained popularity in the years that followed.

After the war, men's wristwatches gained acceptance and style. Watch manufacturers started using images of troops wearing wristwatches to promote timepieces to other men. Men who wore them for the whole war wanted to continue wearing them because they had become accustomed to doing so. As a result, the demand for wristwatches increased dramatically, almost eliminating the market for pocket timepieces.

Once the watch business grew significantly, funding for research and development flowed in. As a result, features including chronographs, quartz movements, practical bezels, and others were incorporated. A more comprehensive range of tasks could now be accomplished by watches, extending their market.

As the world develops, the size of computers has shrunk dramatically over the last two decades. They began by migrating from entire rooms to individual PCs, then came computers and smartphones. We can now fit sophisticated computers into tiny spaces the size of our wrists. The result led to smartwatches such as the Apple Watch. Although vintage timepieces are in high demand, technological advancements have quickly transformed the watch industry. Many of the timepieces you'll come across while browsing watches online are very different from those used in the past. This is because the world we know today results from hundreds of years of development. Everyone, regardless of who they are or what they are looking for, may find a timepiece perfect for them.

If you have ever wondered how to repair a watch or have encountered more concerns and issues than you care to admit, this book is perfect for you! In the chapters to come, we have included some common watch problems and solutions.

Before you begin, keep in mind that repairs performed by anyone other than a qualified watch repair specialist may cause the value of

your watch to decrease. The resale value of a luxury watch is maximized when service records are available, and it's ideal if the manufacturer performs that maintenance. If that isn't an issue, get your hands dirty and learn how to repair watches!

Chapter 1

How a Watch Works

A mechanical watch uses a mechanism to measure time. A mechanism is also known as a movement or caliber. Think of it as the watch's engine. On the other hand, quartz watches measure time by using a tiny piece of quartz crystal with an electronic signal that passes through it, providing a steady vibration. Because of the high frequency at which quartz vibrates, quartz watches are exceptionally accurate.

There are two kinds of mechanical motions: manual and automatic. Manual watch movements, as the name suggests, must be wound regularly to keep the watch running. While fully wrapped, automated motions may save time if worn consistently.

A mechanical watch will usually have a power reserve. The power reserve of a watch indicates how long it will run before stopping. A typical mechanical watch has a battery life of approximately 48 hours.

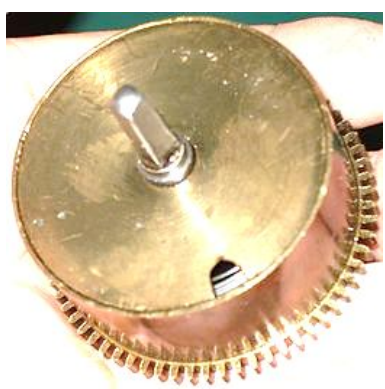
So, with a manual watch, the power reserve is constantly depleted, which is why the watch must be wound regularly. Because of the mechanism's design, an automatic watch can now keep its power reserve. We'll go over how a mechanical watch works in more detail later.

Mechanical Terms Used in Timepieces

Mainspring

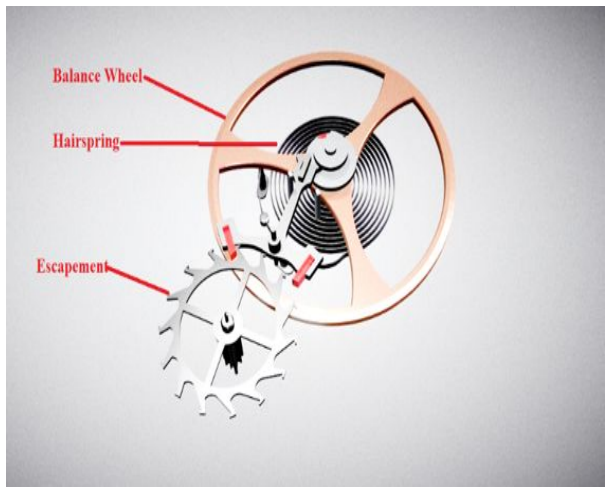
The mainspring is the "gas tank" of a mechanical watch. A narrow ribbon of tightly wrapped metal sits inside the barrel. To start a watch, you wind up the mainspring. It is also the primary factor in the power reserve of the watch.

Barrel



The barrel is nothing more than a hollow gear that houses the mainspring. The barrel must unwind as the mainspring is wound up, which is where the movement's force comes from. The stored energy of the mainspring is transferred to the escapement by the moving train, a series of gears called wheels. The hands of the watch are powered by a separate set of wheels known as the Motion Work, which detach from the moving train.

Escapement



The escapement is ultimately responsible for preventing the mainspring from unwinding all at once. It is composed of several sections. The escape wheel resembles a strangely shaped gear, and the pallet fork latches onto the escape wheel and prevents it from simply unwinding. The pallet fork clicks back and forth, causing the escape wheel to revolve slightly with each movement.

Balance Wheel and Hairspring

The hairspring and balancing wheel are at the heart of the movement. The hairspring is a tiny spring that generates torsion, allowing the balance wheel to return to its original position, and they work together to form the "measure of time." The balancing wheel is the outermost weighted ring of the hairspring, which swings back and forth due to inertia. As it oscillates back and forth, the pallet fork "clicks." The Impulse Pin, connected to the balancing wheel, catches

the pallet fork.

This explains how a mechanical watch works and the different parts. Here are a few more mechanical terms to be familiar with regarding watch movements.

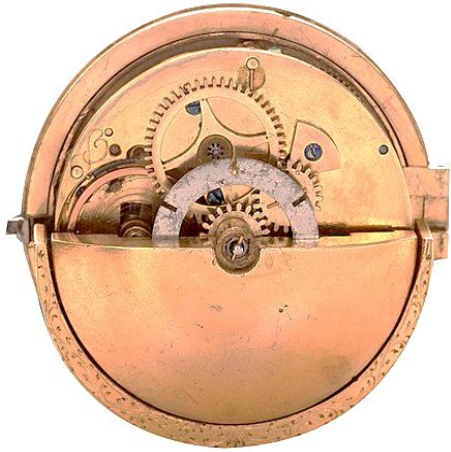
Bridge

The bridge is a piece of metal, usually brass, in which the gears are housed. It's essentially a watch's chassis. A typical watch mechanism will have five bridges.

Jewels

Jewels are small chunks of synthetic sapphire and ruby that improve the accuracy of timepieces. A mechanical watch has these in a few locations. Most gears use jewel bearings to create the least amount of friction possible. These are frequently seen as tiny ruby-colored circles on a movement. Jewels can also be seen on the palette fork and impulse pinpoints. They are employed here to increase efficiency by reducing wear on the movement and lowering friction.

Oscillating Weight



The Oscillating Weight is the mechanism that coils the mainspring mechanically in an automatic movement. This is usually a half-circle weight that uses the wearer's movements paired with gravity to wind the watch.

Three Forms of Mechanical Movement

Quartz

The movement is powered by a battery that emits an electrical signal via crystal quartz, causing the second hand to move in individual ticks.

- Pros: Keeps precise time and never requires winding.
- Cons: The battery must be replaced every 2 to 4 years.

Mechanical

A watch wherein the second-hand moves smoothly.

- Pros: With regular maintenance, a decent mechanical watch will last a lifetime.
- Cons: The movement requires manual winding to function.

Automatic

A self-winding watch in which the mainspring is wound automatically by Kinetic energy from the wearer's arm's natural motion.

- Pros: With frequent use, the watch continues to perform without the need for winding.
- Cons: Automatics are generally thicker due to additional rotors.

Many people regard winding as a form of ritual. Mechanical watches are preferred by vintage and luxury watch lovers. Many mechanical timepieces are created as works of art with meticulous attention to detail. Some are typically designed to survive harsh physical circumstances, such as Rolex Submariner watches, which can function even at ocean depths.

Vintage watches appear to have a distinct quality that makes them more appealing than modern models. Their historical significance, significant international events, notable individuals who wore the watch, its lineage, and who created it all contribute to their allure and value. Furthermore, the further back in time you go, the fewer there are on the market, so each antique clock, unlike recent mass-produced versions, may be unique.

Vintage mechanical timepieces are also superior to quartz, battery-powered, and electronic digital watches. Mechanical watches may be maintained and repaired; however, many quartz and digital watches no longer contain manufactured components.

Vintage vs. Modern Watches

There are two types of watches: mechanical analog and electronic digital watches, which do not contain any moving parts. A third category could be added: mechanical timepieces that power a digital (numerical) display. These were invented in the 1890s. Today, the term "digital watch" refers primarily to those powered by electricity.

Since Hamilton released the first commercial digital wristwatch in 1970, fifty years ago, several "vintage" electronic timepieces have been on the market. The benefits and drawbacks of a vintage watch will be varied depending on whether it is mechanical or computerized.

The Modern Era

During WWI, pocket watches went out of popularity in favor of more handy wristwatches, which many still use today. The first generation of wristwatches employed automated winding, which was far more dependable than their Rococo forefathers. The energy was readily and effectively transmitted into the clock by placing it on the wearer's wrist rather than their pocket, powering the sophisticated mechanics and assuring an accurate watch. The first individual to be credited with creating automatic wristwatch mechanisms is John Harwood, an English watch repairer.

In 1923, Harwood patented the automatic wristwatch. He began mass-producing these watches in a plant in Switzerland in 1928. This provided him the opportunity to sell automatic watches to the public. When ultimately charged, these watches had a battery life of up to twelve hours.

While Harwood is credited with creating the first mass-produced automatic watch, other watchmakers profited from his success. They started by improving on his original concepts. Rolex added weights to the watch, allowing it to absorb even more energy while worn. With the new patented designs, Rolex clocks might be fueled for up to 35 hours.

Eterna Watch used ball bearings in their automatic watches in the late 1940s. This enabled the watch's internal components to regulate motions better, resulting in a more accurate and precise timepiece. The timepieces were also touted as being more structurally solid and long-lasting. What are the latest automatic wristwatches like? Most current timepieces feature automated mechanisms, with only a few exceptions still using manual winding.

Modern Timepieces

It becomes more difficult to compare current timepieces to old watches. There are now so many watchmakers creating watches of different varieties that it might be challenging to choose.

When comparing modern and old watches, the first thing to remember is the variations in how the watches are constructed. Just because a

watch is old doesn't guarantee it's built of better materials.

For example, vintage Rolex clocks were built using acrylic plastic crystals. Acrylic crystals are far less scratch-resistant than extremely scratch-resistant sapphire crystals. Rolex and other high-end watchmakers are continually refining the materials they employ.

On the other hand, modern watches can be constructed inexpensively using poorer materials than many historical timepieces. If they are "vintage," that suggests they have been around for a long time and were well-made with sturdy materials. Many old timepieces are technical wonders in and of themselves. However, there has been significant development in material and technological advancements in recent years.

Smartwatches

Smartwatches like the Apple Watch have been on the market for a few years. They were released on April 24, 2015, and rapidly became the best-selling wearable device, selling 4.2 million units. They are the most "contemporary watch" currently, despite being just five years old.

A smartwatch is a 32GB PC or a mobile phone that you wear around your wrist. There are no glistening jewels or moving hands; instead, you change virtual watch faces digitally. A futuristic wristwatch can send quick alerts, track workouts, and do much more than a traditional watch. Because it is an electronic digital watch, it has a battery. Apart from displaying the time and date, this is one of the few similarities to traditional timepieces. On a single charge, it can run for about 1.5 days. Many companies, including Samsung, Mobvoi, Fitbit Versa, and others, have entered the Smart Watch market.

Modern Watch Mechanism

Watchmakers create many distinct types of watch movements, frequently employing proprietary mechanisms. However, watch movements are classified into two types: mechanical and quartz.

The movement of the timepiece's second hand is one simple technique to tell if a watch is quartz or mechanical. Quartz watch movements

have a tick-tick movement, which means the second-hand moves once per second. The second hand of a mechanical watch will move in a fluid, sweeping motion to signify the passing of seconds. A battery is required to run and operate an internal electrical circuit in quartz and auto-quartz movements.

Mechanical watch movements are further classified into two types: manual movements and automatic movements. Mechanical calibers consist of numerous small gears and springs inside the clock. They are usually more expensive than battery-powered timepieces because they need a more labor-intensive manufacturing process. Although a battery-powered watch is more precise, watch lovers and connoisseurs prefer automatic or manual timepieces. These one-of-a-kind clocks embody hundreds of years of watchmaking expertise, skill, and invention.

Automatic watch movements are also referred to as "self-winding" movements. These calibers rely on the wearer's natural wrist motions to power the clock. Automatic watches are easy to wear, use, and maintain since they do not require daily winding to guarantee proper performance and accuracy. If the watch is worn daily, the owner will not have to wind it by hand to keep it running.

How an Automatic Watch Movement Works

A rotor, which is a metal weight, powers an automated watch mechanism. The rotor within the watch will freely oscillate. Every time the wearer moves their wrist, the rotor rotates. This natural spinning action is converted into energy and used to wind the watch's mainspring. The mainspring stores energy.

Is winding an automatic watch still necessary? In some cases, yes. Regularly worn automatic watches will primarily power themselves. However, if the watch is not worn for an extended period, the internal mechanisms must be wound.

Essential Parts of Watch Movements

Mainspring

The mainspring is the source of power for automatic watch movements. When an automatic watch's crown is wound, kinetic energy is transmitted to the coil mainspring. As more energy is saved, the mainspring tightens, storing even more energy for eventual use.

Crown

A crown is a tiny wheel on the side of the watch. The crown is moved, allowing the watch to wind and operate.

Gear Train

The mainspring's stored energy is permitted to travel via the gear train, a tiny series of internal gears that moves the watch hands and other portions of the watch face.

Escapement

The escapement serves as the internal braking system of a timepiece. The energy transferred from the mainspring to the gear train is released in equal halves, a process known as escapement.

Balance Wheel

The balancing wheel is an internal component that beats in a circular motion five to ten times per second.

Dial Train

The dial train is a comparable sequence of gears to the gear train. The dial train delivers equal energy from the balancing wheel to the watch hands, allowing them to move.

Jewels

Jewels are synthetic rubies placed in the middle of the gear to keep it in motion and reduce heat and friction damage.

Rotor

The rotor is a half-circle-shaped metal weight. The rotor is linked to the movement and may freely swing when the wearer's wrist moves. When the user moves, the rotor delivers power to the mainspring and twists it, where the energy is subsequently stored. When the mainspring is completely wrapped, a clutch connected to the rotor engages. The clutch prevents the rotor from further winding the mainspring.

Chapter 2

Useful Tools for Watches and Clocks

Suppose you're a beginner in the field of horology. In that case, you'll be awestruck by the sheer number of tools and materials available to you in the tool and material catalogs of firms that specialize in the field. It is common for the worker to own his tools, and it is acknowledged that a complete set costs a lot of money. A newcomer should not be concerned about this issue because it is possible to begin working with only a few fundamental instruments.

The necessary tools can be obtained as new skills are learned. Most horologists gradually build up their toolkits over time. Horology appears to be the type of semi-profession where skills develop sequentially from one prerequisite to the next. As a result, the tool required will also gradually increase.

Watch Tools and How to Use Them

Watchmaking and watch maintenance is a fascinating career, but with

so many watch instruments available today, it is easy to become confused or even carried away. Listed below are some essential watch repair instruments that any professional horologist should buy as a bare minimum.

Case Opener

Before you can get inside a watch, the first step is to examine what's wrong or perform a routine servicing by removing the watch's back and/or front.

Based on the type of watch, you may need to screw or lever the back and front of the watch apart. Screw-back watches need specialized equipment such as an adjustable Jaxa tool or the watch manufacturer's proprietary screw-back removal tool.

A primary case opening knife can be used to remove the Snap-On front and rear watches. Case opener knives have a short, blunt blade placed into the chamfer of a case back and then turned anti-clockwise to snap the case back off.

Some case knives have a sharp blade on one end and a case knife on the other. These are great since they can sharpen and shape your Pegwood and open watch cases.

Watchmakers Screwdriver Set

After removing the watch, you must remove it from its case by removing the stem and the case retaining screws. You will need a set of watchmaker's screwdrivers for this, which should be the second item in your watch repair kit.

There are long disputes over which screwdriver is the finest; in my opinion, Horotec quality has a slight advantage.

Here are the commonly used four sizes for the majority of watches:

- Grey - 140
- Red - 120
- Black - 100
- Yellow - 80

Tweezers

After you have undone a screw with your screwdriver, you must pick up the screw and move and replace the watch pieces with a pair of tweezers—another essential component for your watch repair kit.

Tweezers for watchmakers are not the same as cosmetic tweezers. They feature highly accurate ends that fit together correctly and are simple to use.

There are hundreds of different sorts and forms to select from; however, most watchmakers will agree that the following should be employed at the very least:

- No. 2 - Strong with Fine and Flat Tips
- No. 3 - Finest Points
- No. 5 - Extra Fine and Short for Hairsprings
- Brass AM - for non-tagging of watch parts.
- Plastic - (optional if dealing with quartz movements)

Choosing non-magnetic tweezers is a smart option since having watch screws attached to your tweezers may be a real pain. The tweezers are held like a pen between the thumb and first two fingers, and with experience, you should be able to rotate them around 360 degrees while holding your watch components between the tweezers' points.

Eyeglasses or Eye Loupe

Eyeglasses, like most watch instruments, come in various forms and sizes. No need to be concerned; you will only require two types:

- General Eyeglass (3 - 4 times magnification)
- Inspection Eyeglass (10 - 12 times magnification)

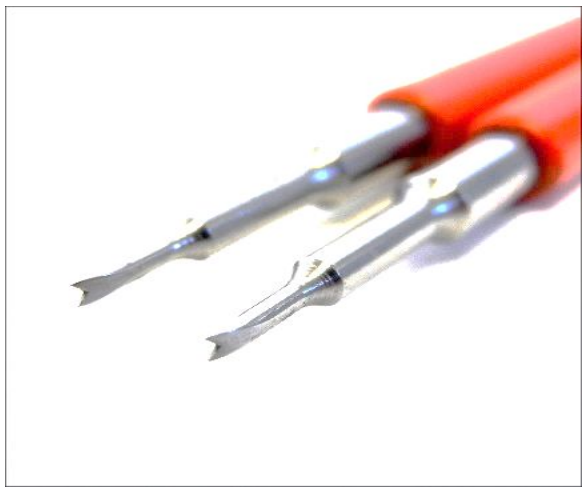
Most of the time, your general eyeglass is used to disassemble and reassemble your watch. The inspection eyewear is only used on rare occasions to obtain a better look at pivots, jewels, or for closer inspection.

Eyeglasses of high quality are numbered, for example, No. 1, No. 2.5,

and so on. This number refers to the focal length. Thus, a 1 indicates you'd concentrate 1 inch away from the item, and a 2.5 means you'd focus 2.5 inches away from the object. The closer you are, the more eyestrain you will get. Thus, it is ideal for working at a comfortable distance for as long as possible.

If you have trouble keeping your glasses in place, you might want to consider a wire eyeglass holder.

Watch Hand Lifting Levers



You must first remove the hands from your watch before removing the dial. The Presto Automatic Hand Lifting Tool and Hand Lifting Levers are two tools that can assist you with this task.

Do not damage the dial or the hands themselves when removing the hands. The hands must be removed vertically, which the Hand Lifting Levers do admirably by swaying and driving the hands higher.

Placing dial protection or a thin plastic seal bag on top of it is common practice to avoid damaging the dial. The Presto hand removal tool is helpful, but be wary of the little plastic feet that drop and press on the dial face.

Movement Holder

It is not suggested that you contact the watch movement with your fingers after removing it from its case; instead, a movement holder is used to secure the movement for working on carefully.

Movement holders exist in various forms and sizes, but the conventional holder is reversible, allowing it to accommodate different sized motions, smaller on one side and bigger on the other.

Parts Container

Part containers allow you to keep the various pieces of the watch separate as you disassemble and reassemble them. They should include a cover that prevents dust or debris from falling on the watch components after removing and cleaning them.

Peg Wood

Peg wood is long-lasting and has a consistent size and shape. Many people attempt to use toothpicks or wooden kebab skewers, but these are too soft and lose their shape.

Peg wood is used in the watch repair industry for various tasks. The two most common are cleaning out jewel holes and watch components before cleaning the watch with chemicals and holding down parts and springs during assembly and reassembly.

A sharp knife is also required to dress the end of the peg wood, which comes in two shapes: point and flat.

Benzine Glass Jar and Watch Degreasing Fluid

You'll need to clean your watch with a watch cleaner after you've stripped it down and cleaned all jewel holes with a peg wood.

Watch repair professionals will use ultrasonic watch cleaning equipment to remove dried oil, dirt, and grime from all watch components.

However, because watch cleaning equipment is expensive, the novice can do it by hand with a benzine jar and some cleaning solution.

Even if you purchase watch cleaning equipment, a glass benzine jar filled with a degreasing solution is always handy for quickly removing grease if an oiling procedure goes wrong or watch components become contaminated.

Make sure your benzine jar has a tight-fitting cover to prevent evaporation. You should also get a small paintbrush to help clean your watch components after they've been in the fluid.

Rubber Dust Blower

As you may be aware, dust and dirt are a watch's worst enemy. You should never blow on a watch with your mouth since your mouth contains moisture and contaminants that will only deteriorate the watch's performance.

Rubber dust blowers are affordable and effective in removing dust and debris from your watch and drying parts after cleaning. So, after cleaning a watch part in your benzine jar, set it on a piece of paper. Holding the watch component with tweezers, blow-dry the watch part with a dust blower.

When drying watch parts with a blower, exercise caution since dust blowers may be strong, and if the watch component is not firmly gripped, it can be blasted away.

Watch Oils and Greases, Oilers, and Oil Pots

After you've cleaned your watch parts, it's time to reassemble the watch. As you reassemble the watch, apply oil and grease to any spots where there is friction.

Oil pots should be used to store all oils and greases. You can purchase a single pot for each oil or a platform with three or four pots. All oil pans should have lids to prevent contamination.

So you've got your oil and grease, but how do you get it from the oil pots to the watch parts? For this, you'll need a watch oiler. Watch oilers have a colored handle, a metal stem, and a "spade-shaped" design at the tip. There are four sizes to choose from:

- Red - large tip
- Green - medium tip
- Blue - fine tip
- Black - very fine tip

Simply dip the oiler into the oil and then rub it against the watch component to transfer the oil. Holding the oiler vertically allows the oil to enter minor crevasses.

Rodico Cleaning Putty

Rodico is a cleaning putty with many uses, but it is most commonly used to remove fingerprints, oil, dirt, and grime from your watch mechanism. Rodico works as a pencil eraser does; simply wipe or dab it across your watch movement to reap the benefits. Another excellent use for this fantastic putty is to remove stubborn jewels or screws from your movement.

Clock Tools and How to Use Them

Screwdrivers

Collect a variety of screwdrivers ranging in length from 50mm to 200mm (2in to 8in) and blade width from 1.5mm to 9mm (0.06in to 0.4in). The most frequent pattern is the so-called 'London pattern,' which has the blade in line with the handle (a somewhat old-fashioned phrase). Larger screwdrivers will have the traditional wooden or plastic handle; smaller screwdrivers should be of the clockmaker's kind, with a cylindrical handle and a hollow at the top for a steadying forefinger to rest in.

Because most screw slots were cut by saw, often in large quantities, the end of the blade should be hollow-ground for use on screws made after the middle of the nineteenth century. Previously, the slot was created with a file and was not parallel-sided; if you are likely to come across many antiques from this era, keep a screwdriver with a tapered blade on hand.

Tweezers

Tweezers are required in several situations to pick up or push pieces into place. They are smaller, harder replacement fingers with clearly defined ends that do not obstruct the handling of small parts. They should be chosen as needed. Many household items are useful and frequently magnetized as a bonus. However, you will require a non-

magnetic pair or two, which can be purchased from clock tool vendors. Tape two 'fingers' of a pair of feeler gauges together at one end and shape the other to fit the job as an emergency measure. Thinner fingers (0.075mm to 0.15mm or 0.003in to 0.006in) are most useful.

Pliers

Pliers remove taper pins from clock pillars and posts, hold or manipulate clock parts during assembly, and bend or cut materials. For the first of these activities, a flat-ended pair with a groove cut across the end of one jaw is required. The entire length should be 100mm to 150mm (4in to 6in), and the jaws should not be thin or 'snipe-nosed'; they would not be strong enough to extract partially rusted pins from old clocks.

Slender jaws are required for the pliers that grip arbors and other pieces when building a clock mechanism.

Simple, strong pliers 150mm to 200mm (6in to 8in) long will work very well for the mechanical task of bending wire and changing the 'set' of levers — broad jaws that will not deform when put under tension. Two pairs are recommended if you want to utilize one pair for retaining work during heat treatment or soldering. The jaws become soft, and the impacts of heat and fluxes corrode the joint and general region of the jaws.

Cutting with pliers necessitates the use of a competent set of side-cutters, as well as maybe a pair of end-cutters. These will be used to trim taper pins that are excessively long and pivot steel for springs and other minor parts. Regarding capacity, most of the cutters shown in the clock tool catalogs appear to be restricted to roughly 1mm (0.04in) brass wire.

Brass Brush

The finest approach to cleaning the teeth of a clock wheel is clean and appealing to the eye. The brass brush will also remove tarnish from brass items while leaving no trace of metal behind.

Lighting

In addition to adequate overhead illumination, a 60-watt bench lamp with an adjustable shade is required. Ensure the power outlet is in a convenient location so that cords do not trail over the bench or your feet.

Material for Clock

Cleaning solutions will be required before work can begin. On alarm clocks, high-test gasoline or white gasoline may be used. Still, in the superior grade of clocks where the movements are entirely disassembled, specially prepared cleaning solutions offered by material dealers are preferable. A rather firm washout brush is necessary to clean a clock mechanism. Clean the holes in the plates with peg wood and dry the plates, wheels, and other parts with chemically treated sawdust.

Clock pins and clock washers are also required because they are frequently missing from the clock or are lost during the repair process. A bottle of clock oil and an oiler, which can be bought or made from a large broach, is required. Various clock bushings are ideal, but these can be made to order. Pendulum rods and mainsprings are frequently purchased as needed.

Chapter 3

How to Reassemble and Overhaul a Watch

Modern, high-quality timepieces demonstrate man's ability to create precise instruments to a great extent. We should also mention that the same skill set is required to become an effective repairman. Many delicate processes necessitate years of hard work to complete correctly. Furthermore, as the learner masters each theoretical premise and technical challenge, he will discover that the task grows more interesting and opens up new avenues of intellectual exploration. Perhaps no other piece of equipment performs a single function while utilizing as many physics principles as the small mechanism housed in a watch casing.

Cleaning and Lubrication

Removing Movement from the Case

We feel that the best way to learn watch fixing is to start with the watch itself, taking it apart piece by piece, carefully inspecting each part, and noting the function and purpose of each piece.

The first step is to remove the movement from the casing. It appears easy enough, but particular procedures must be followed to avoid parts breaking. The tools required for the job will be discussed as we go.

To begin, we'll need tweezers, a 3-inch eye loupe, a set of watch screwdrivers, a movement holder, and a case opener. Case structure varies greatly; we will look at the most common varieties and approaches for removing movement from the case. Both pocket and wrist cases include a Snap-On back and a bezel (front that holds the crystal). In this method, they are pried off.

Let the crown move slowly between the thumb and first finger once you've released the click. Place the watch on the bench, train side up, and back out the screw SS (setting lever screw) with a couple of twists. This frees the stem, which may now be extracted. Remove the case screws and push the movement out.

Some older American timepieces are not designed in this manner. Pull

the stem out to the point of setting the hands, remove the case screws, and push out the movement instead of backing out a screw. Except when these pieces need to be replaced, the crown, stem, and sleeve stay in the case.

Many modern wristwatch casings are two pieces. Pry the bezel off with the case opener. Then, twist the blade with a large watch screwdriver to remove the movement. Make sure the screwdriver does not enter the balance position.

Water-resistant casings have emerged in recent years, and opening them necessitates using various wrenches and other tools. Like the three-piece case, the stem must be removed before the movement can be removed.

Another type of water-resistant casing is pried open using an unbreakable crystal. In these cases, the stem is extracted using cutting pliers. Other models have a casing that can be opened by pressing down on the crystal and releasing the back. Others are connected with screws or slides. In most cases, little research will reveal the strategy required to open the case. And if you have any reservations about the procedure, proceed with caution.

Dismantling the Movement

Replace the stem and tighten the screw SS after placing the movement in the movement holder, train side up. Remove the balance from the bottom plate by loosening the balance spring from the balance bridge. Place the balance in one of the holes on the bench block. Never place the balance on the bench, either before or after cleaning. Placing the balance on the bench block protects the balance pivots and keeps them clean after the balance is cleared. Remove the following watch components in the order listed:

1. The hands, using the hand remover
2. The dial
3. The hour and minute wheels
4. The cannon pinion, using the cannon pinion remover
5. The pallet bridge and lever, but make sure the mainspring is already let down
6. The ratchet and crown wheels

7. The train bridges
8. The barrel bridge
9. Finally, the train wheels and mainspring barrel

Place the barrel, cap side up, on the bench block (two bench blocks are required), and pry off the cap with a small screwdriver. This should be done with caution, as the arbor and mainspring may fly out unexpectedly, and you will spend the rest of the day searching for a barrel, a barrel cap, a barrel arbor, and a mainspring. With hefty tweezers, gently remove the arbor, hoping you are not so unlucky. Turn the arbor to disconnect the mainspring and remove it. Now take out the mainspring.

A hole jewel and a cap jewel keep the balance on each end. This configuration is necessary to reduce friction. Cap jewels are always removed during cleaning, and if they are attached to the lever and train, make a note of the jewel settings and the plate before removing them so they can be restored to their original positions.

Cleaning the Watch

The lower plate and bridges are strung on a looped wire and immersed in a jar filled with a watch cleaning solution available from material dealers. Allow the pieces to soak in the solution for a few minutes before brushing thoroughly with a soft brush previously dipped in the cleaning solution. Rinse in warm water and then dip in alcohol or a specific drying solution available from material dealers. Shake the pieces in heated boxwood sawdust until they are dry. The wheels are strung individually on the wire and cleaned similarly. If the mainspring is not set, it can be used again. (The phrase set means that the spring's flexibility has been gone.) A spring should expand to approximately three times the diameter of the watch mechanism. If not, a new spring should be installed. Clean and dry the mainspring in the same manner as the other parts.

The lever, jewels, screws, and other small items that cannot be strung on the wire are placed in a shallow container with a cleaning solution. These are removed one at a time using special tweezers designed to keep small objects, such as jewels, from flying away. Hold the jewels with the same tweezers against a piece of hard pith and clean with a

brush already immersed in the cleaning solution. Clean the lever and other minor pieces in the same manner, then lay each piece out to dry on a sheet of paper. The jewels are cleaned even more thoroughly by inserting a pointed piece of peg wood into the hole. Cleaning the cap jewels involves rubbing them with a flattened piece of peg wood at the end.

Separate cleaning is required for the balance. Examine the pivots with a 12-inch eye loupe after inserting them into a piece of firm pith. If they are smooth and highly polished, clean them by dipping them in the cleaning solution, then in the drying solution, and finally in sawdust until dry. If the balance pivots are tarnished, use potassium cyanide to clean them entirely after dipping them in the cyanide.

Warning: Cyanide is a highly toxic toxin. If the pivots are significantly rusted, polish them in the lathe using the technique described in another section of this chapter.

Assembling the Movement

The watch has now been cleaned, and an examination reveals that all components are in good working order. Replace the cap jewels and apply watch oil to each hole jewel. Insert a tiny wire through the hole jewel to push the oil to the cap jewel. A pivot broach set to a piece of peg wood and ground to fit freely into the hole of a tiny hole jewel creates an excellent instrument for pushing the oil through to the cap jewel. It's also useful for testing escapement freedoms.

Examine the cap jewel with a pivot eye loupe and note the size of the oil bubble. More oil is usually required to make the desired size bubble. The oil bubble isn't always concentric with the hole in the jewel. A little eccentricity won't hurt you. The cap jewel or hole jewel is out of flat and must be adjusted if the bubble is very eccentric. A proper-sized oil bubble will not form in a few cases. This indicates that the jewels are too far away and must be adjusted. Too much oil is visible if the bubble fills the entire cap jewel. Remove the cap jewel, clean it, and replace it in this case. The correct amount of oil is essential if the watch works typically between cleanings.

Install the balance to the bottom plate and check the balance spring to ensure it is flat and concentric to the staff. Assume it is insufficient

and incorrect, as directed in another section of this chapter. Remove the balance and bridge and place them on the bench block, assuming the spring is in good condition. Oil all of the frictional surfaces of the winding mechanism. Using a mainspring winder, attach the mainspring to the barrel. Lubricate with watch or clock oil. Oil every other tooth on the escape wheel and press the pinion end of the escape wheel into a piece of the firm pitch.

Place the barrel and train wheels on the bottom plate and fit the bridges, making the wheel pivot in the holes before screwing the bridges down. For end shake, try all wheels. The end shaking on the fourth, third, and center wheels should be more than on the escape wheel but not severe. Adjust the lever to the movement and lubricate the train jewels. Wind the mainspring up and check the lever for freedom. Lifting the lever away from the banking pin against which it is leaning accomplishes this. It will immediately hop to the opposite banking pin if it is free. Place the balance in the watch; if there are no basic flaws, the balance will move freely.

Watch Repairing

Mainspring Problems

Mainspring Gauges

There are two methods for measuring mainsprings. These are the Dennison and metric scales. We believe the metric is superior because it allows for more precise measurements. The thickness may be measured with a metric micrometer and the breadth with a vernier gauge.

Swiss Mainsprings

On Swiss mainsprings, a tongue end is common. In the barrel, these springs occasionally fail to connect. The problem is usually solved by shaping and filing the tip of the tongue. If this doesn't work, use a sharp, long-pointed graver to undercut the barrel step. A punch mark on the barrel often indicates where the cap is snapped. This could save the horologist a lot of time, as the barrel may not run true in the flat until the cap is fitted correctly.

Attaching the Hook to the Barrel

The barrel hook is occasionally defective or damaged and must be replaced. Certain requirements must be properly followed while creating a new hook.

They are as follows:

1. The hook must be robust enough to withstand all forces

when fully wrapped in spring.
2. The hook should securely retain the spring to the barrel wall.
3. The hook should be as small as feasible to allow for the use of a tight hole in the spring, resulting in increased strength at that point.

One method for constructing a hook is as follows:

1. Drill a hole in the barrel at an angle so that it is correctly centered on the interior of the barrel. Using a tiny tap, thread the hole.
2. Next, file a piece of mild steel wire to a small taper with a pin vise. Make a thread with the screw plate on this wire that is the same size as the thread in the barrel hole. Threading will be done at the taper's widest point.
3. Continue until a whole thread is cut; then cut the wire, leaving enough height to form the hook while the wire remains in the screw plate.
4. After you've filed the hook, take it from the screw plate and screw it into the barrel from the inside.
5. Tighten tightly using the wire portion that sticks outside the barrel. Cut the wire and use a tiny escapement file to level the barrel.

The hole at the spring's outermost end should be treated with the same care as the hook. Blue the spring end as far back as possible. Punch the hole as close to the hard section as possible, allowing about 2 millimeters of spring to extend beyond the hole. This section beyond the hole is bent slightly to fit the circular shape of the barrel wall. The hole should be large enough for the hook to enter easily, and the end of the hole should be beveled to secure the outer coil against the barrel wall.

Fitting the Cap to the Barrel

File the circle of the cap lightly. The glazed surface is therefore roughened, and the cap is typically retained.

Fitting Stems

When the factory stem for a certain watch model is available, no fitting is necessary other than reducing the stem to bring the crown to the precise height. However, the appropriate stem is not always accessible, and some degree of fitting is necessary. There are also instances where the plates are severely worn, and stems with bigger hubs are required.

After determining the approximate size of the stem, estimate the size of the pivot. This may be discovered by placing a tiny drill into the pivot bearing. The pivot is now rotated to the necessary size, followed by the hub. Using an escapement file, reduce the square. This is performed by holding the stem in a pin vise and filing with an eye loupe.

Removing Broken Screws

It is frequently difficult to remove damaged screws. A sharp graver can be used to move the remaining piece on occasion. Sometimes a slot can be filed with a screw head file and removed with a screwdriver. If none of these methods work, make an alum solution with one part alum and five parts water. Everything should be thoroughly combined. Remove all steel pieces and soak the plate or bridge in the solution for about 12 hours. The screw will corrode, but the brass or nickel plates will be unharmed. In some cases, twenty hours or more are required.

Repairing the Main Train

Closing Holes

The horologist's day-to-day job is to repair holes in watch and clock plates and bridges. This can be done with the staking tool if the holes are not heavily worn. Insert a flat-faced stump into the die of the staking tool frame that fits easily into the plate or bridge recess. Tap the hole with a round-end punch large enough to fit the oil cup and prevent the pivot from going in. Broach the hole until it fits perfectly. Place the wheel between the plates and examine the final shaking. The terminal shake should be about one-third the diameter of the pivot. If the plate does not have friction bushings, the best way to reduce

excessive-end shaking is to construct or redesign a stump by turning a little hollow on its face.

When the hole is closed, the plate's metal sinks into the hollow of the stump, reducing end shaking. If the end shaking is not present, the operation must be reversed. In the dial-up and dial-down positions, the wheel should be able to spin between the plates freely. Because today's horologists can use friction jeweling, it's simple to broach the holes to the desired size and press friction jewels.

Replacing a Bezel-type Jewel with a Friction Jewel

The first step in fitting a friction jewel is determining the depth at which the jewel should be positioned to get the desired end shaking. This is performed by employing a machine explicitly designed for the task. Place the pusher on the broken jewel and adjust the metric screw at the machine's top so that the new jewel is pressed to the same depth as the damaged one.

Next, remove the shattered jewel and ream out the hole using the smallest reamer that will cut away enough metal to leave a clean, straight hole in the plate. Now choose the appropriate jewel whose outer diameter is 1/100 of a millimeter bigger than the hole in the plate. With the wheel countersinks, remove the burr left by the reamer. Finally, insert the jewel over the plate's hole, bottom side up. It should penetrate slightly without the machine's assistance. Lower the pusher to the jewel and push it in place with hard pressure. The previously adjusted metric stop will stop the pusher's movement when the correct depth is achieved.

Replacing a Friction Jewel

Simply measure the size of the hole in the plate to replace a jewel in a watch that previously had a friction jewel. This can be accomplished by inserting the reamer or using a gauge designed for the purpose. After determining the size of the hole, select the required jewel and insert it to the proper depth.

Cleaning Dials

The silver dials seen in contemporary timepieces are frequently

tarnished and dirty. If the figures are baked, the dials can be cleaned by immersing them in a potassium cyanide solution. One-half ounce of cyanide is dissolved in a quart of hot water, followed by two ounces of strong ammonia. Heated water should be used to rinse the dial, and it should be dried in warm sawdust or dryer.

Painted dials, on the other hand, will be destroyed due to the removal of the figures. These dials can be cleaned with baking soda. Wet your first finger, dip it into the baking soda, and gently massage the dial. Wash gently, rinse with warm water, and dry in warm sawdust or dryer.

Magnetism

Magnetism causes a watch to gain or lose time or to stop completely if sufficiently magnetized. To test for this condition, remove the back of the case and place a compass over the balance wheel and winding wheels. If the watch is magnetized, the needle will be diverted.

To eliminate magnetism:

1. Insert the watch into the demagnetizer and gently draw it to about 2 feet while the current is maintained.
2. Re-test the watch.
3. If magnetism remains, continue the preceding technique until the compass needle rests.

Never try to demagnetize the balance spring when it is out of the movement.

Hands Fitting

Check that the hands have enough space. Make sure the hands are parallel for most of their length. The minute hand's outer end should be slightly curved toward the dial.

Restoring Rusty Hands

If your hands are rusty and otherwise unappealing, you can make them look new by touching them up with India drawing ink. Sharpen a peg wood piece to a point and liberally ink the hands. Smoothing

the hands first with an Arkansas slip is sometimes preferred. To better read the time, the consumer may prefer black hands over gold or silver hands. These can also be blackened with Indian ink.

Dial Train Repair

Tightening the Cannon Pinion

The cannon pinion must fit over the center wheel's post with sufficient friction. Without enough friction, the cannon pinion will slip, preventing the hands from moving.

Most staking tool sets contain the tools required to tighten cannon pinions. Insert a V-shaped stump into the staking tool frame's die. Insert a circular broach into the cannon pinion, then place it on the V-shaped stump. Choose a chisel-shaped punch and lightly pound the cannon pinion with the brass hammer to close the hole in the cannon pinion. Fit the cannon pinion to the center post and feel the friction by moving the pinion with your tweezers.

Many modern timepieces feature a blind cannon pinion or a pinion with the end closed. On this type of pinion, we can't use a broach. Shorten a broach until it fits the cannon pinion with some friction, then save it for later use. Repeating the process on additional projects will result in a collection of similar brooches forming a set. These could be mounted on a block or box and numbered according to size. Six broaches should suffice.

Install the hour wheel on the cannon pinion once it has been fitted to the watch. Check that the wheel fits freely. If it binds, slightly broach out. Place the dial in place and observe the hour wheel shaking. If space allows, always use dial washers. Because the tension should be low, flatten the washer. Dial washers help to keep the minute and hour hands apart, making them less prone to snag on each other. It's also worth noting that the dial's hole is centered on the pipe of the hour wheel. The hole in the dial is frequently not centered, causing the hour wheel, with the hour hand attached, to bind in the hole. Remove the dial and use a tiny round file to center the hole concerning the hour wheel. Replace the dial after removing the burr with the wheel countersinks.

Chapter 4

Common Watch Problems and How to Repair Them

The Timepiece Stopped Ticking

If your timepiece stopped ticking, the battery is most likely to blame. This may appear to be a simple watch repair, but it is something you shouldn't overlook. The very first thing you should do is check the battery. Many watch batteries have a lifespan of two years, which can rise to three years or more with a quartz watch as it is designed to last longer. So, if your watch has stopped working, you will most likely need to replace the battery.

Watch Battery Replacement

The comprehensive methods for changing the watch battery on your own are provided below.

Regular Quartz Watch

For a regular quartz watch, start by facing the watch down. Use a clean workplace to avoid scratching the watch crystal.

1. Check the rear of the watch for a small hole or gap. The manufacturer left this in place to make opening the watch back easier - install a sharp tool that will fit into this area.
2. Pull the watch's rear cover apart with a strong set of tweezers or a tiny knife or screwdriver point. Before pressing down on the watch back, be sure the little tool is robust enough to sustain bending damage.
3. Once you remove the watch's rear cover, you should be able to view the old battery.
4. Remove the old battery from the watch motor using tweezers or a tiny flat knife.
5. In most situations, little metallic clamps keep the battery in place. Using your tweezers, gently pry them up. But not too much, or they'll snap.
6. Replace the old battery with a new one.
7. Examine the watch's face while holding the watch back firmly to check that the battery is functioning.
8. Replace the watch band. Make that the watch case's

teeth are snapped into the matching holes on the watch frame.
9. Once you've set the right time, you're ready to go.

Quartz Watches with Screws

For quartz watches with screws, locate the screws on the back of the watch and find a screwdriver that will work with them.

1. Remove all the screws from the rear of the watch with care, store them properly, and then rebuild the casing.
2. Complete the remaining watch battery replacement methods listed above (pointers 5-8)
3. Replacing and tightening watch screws to the watch
4. Set the timer, and you're done.

Swatch Quartz Watches

1. On the rear of Swatch quartz watches, there should be an indentation. These spaces are big enough that you won't have to look for them.
2. Get a coin to fit inside the indentation (a quarter usually works fine). If the quarter doesn't work, try a penny or dime coin.
3. While the coin is in the indentation, rotate it counterclockwise. This should separate the watch back from the watch frame.
4. Follow points 5-8 in the first set of instructions to install the new batteries.
5. Replace the watch case's back. Replace the coin in the indentation and rotate it clockwise to finish the rotation. Otherwise, it might not lock in place.
6. Finish by setting the timer.

Don'ts in DIY Watch Battery Replacement

You can make a huge mess in seconds, as much fun as changing your watch batteries. Avoid these and other typical errors.

1. Unplugging the Watch Battery

You may bang the open watch against your hands to cause the old battery to fall out, but do not make the same mistake twice.

The watch engine and movement are so delicate that they will stop working if not correctly cared for. You don't want to cause any damage and then blame yourself for it by opening the watch. If done correctly, replacing the watch battery should take about 10-15 minutes, so there's no need to rush through any steps.

2. Incorrectly Pushing Down on the Watch Casing

The many types of watch case backs and how to remove them have been described. You should, however, remember to replace these casings properly. Even screw-in cases have set teeth that align with the watch case in different places on occasion. Before pressing the rear case down, make sure it is correctly adjusted. If you don't, you risk destroying the rear cover and some of the watch's internal components. It should snap back into place with a secure fit if done correctly.

3. Making Use of Inefficient Tools

I purposefully picked odd tools for this list. They are tools you can typically find around the house, so there is no danger of hurting the watch. However, in some instances, terrible tools can still be used. Using a tiny screwdriver, for example, to pry the watch apart may cause the threads on the screws to wear away. It will be practically hard to work on the watch in the future since the back will not come off. In addition, you may have difficulty reinstalling the screws after replacing the watch batteries.

4. Incorrect Arrangement of Batteries

When removing the watch case, look at how the batteries are arranged in the watch engine. This keeps you from forming a bad connection. Similarly, two timepieces in your collection might be similar or not. The fact that the batteries in one watch are facing down does not imply that the batteries in the other watch are facing down. Even if the same company manufactures the timepieces, double-check the location before removing the old one.

5. Incorrect Battery Selection

The mere appearance of two timepieces does not mean they utilize the same batteries. Your watchmaker will probably utilize lithium-grade batteries in the watch engine, although even seemingly equivalent lithium batteries may not be. Check the rating of the existing equipment before obtaining fresh batteries. Otherwise, you risk providing your watch with a defective battery or offering more power than it requires. In any scenario, it's awful news.

The Second Hand is Skipping

If the second hand of your timepiece is skipping, your battery is nearing the end of its useful life. It’s also important to deal with the problem as quickly as possible, as a faulty battery may leach acid into your watch, causing it to malfunction.

If the second hand is caught in a back-and-forth movement in one location, there’s a problem with the movement that’s more serious than a simple home repair.

My Watch is Running Fast (or Slow)

Nothing should be done if your watch is running fast (or slow). This isn't always a problem with the watch. A small amount of time is

gained or lost by watches every day. While the changes are small and gradual, the cumulative effect may give the impression that you have a significant problem. However, there should be no issue unless you lose more than a few seconds per day.

The Buttons Won't Bounce

Dust is most likely to blame if the buttons on your watch do not pop out after being pressed in. Even though your watch case is sealed, dirt can build and become trapped in the springs that allow the buttons to pop out. Professionals use ultrasonic cleaners to remove dirt safely. However, you may remove the dirt with plastic tweezers and a little piece of absorbent paper. Take it to a professional if you can't readily reach the tube containing the spring. Touching the spring with your fingers may add lubricants that aggravate the condition.

Vintage Watches Repair

The Winding Stem and the Crown

It's very uncommon to find timepieces without their crowns, either because they fell off or the owner never bothered to repair them. If this is the case, you will be unable to wind or regulate the watch.

You'll see a little screw on the bridge near the crown if you examine the movement attentively. This screw, linked to the winding stem that goes into the watch, holds the crown in place. If the screw gets loose, the stem might slip out of its lodging. Regardless of this phenomenon's inconvenience, it is typically easy to repair. Because watches are mass-produced, the movements are standardized, making it possible for skilled watchmakers to locate replacements for practically any model. This implies that all you have to do to discover the correct winding shaft is determine which movement is powering your watch.

The Main Spring and the Barrel

Two large gears are visible close to the crown on a standard watch mechanism. These two gentlemen are responsible for winding the watch. The barrel, a hollow metal cylinder containing the mainspring,

is located beneath the second wheel on the right. The mainspring powers a mechanical watch. It is wound around a central axis, and twisting the crown twists and winds the spring.

These daily wound springs can fail, resulting in the watch losing power and stopping cold. How can you tell if the mainspring is damaged? If you turn the crown and hear the gears clicking but encounter no resistance, the problem is most likely a broken mainspring. If this is the case, rejoice: it is usually not a major issue. The watch needs a new mainspring, which any skilled watch repairman may readily replace. Some may be more difficult to obtain and more expensive, but the watch will typically be repairable.

The Balance Wheel Assembly

We now proceed to the opposite end of the watch mechanism, where we discover another prominent wheel. Because of a tiny little spiral above it, this is the balancing wheel, which oscillates back and forth in only one direction and then the opposite at a frequency of 5 to 10 times per second (called a hairspring).

As you might expect, this fast-moving component is among the most sensitive on the watch. This is especially true given that two small pivots support this wheel. When a watch strikes a hard surface, the shock is conveyed to these two pivots, which can occasionally shatter. If this happens, the balance wheel will cease oscillating, and the watch will stop. You may inspect the condition of the balance wheel staff and its pivots by gently twisting them with a pair of tweezers.

If it wobbles, it is most likely due to a broken pivot. When this occurs, the repercussions are far-reaching. While a watch repair technician may readily get a new balance wheel assembly for the most popular watch movements, if you have a more exotic one, you're out of luck because constructing a balance staff from scratch is difficult, time-consuming, and expensive. If, on the other hand, the balance wheel usually oscillates, it signifies there is most likely no damage, and the watch movement merely needs to be cleaned! If you come across a watch that you can't turn the crown on (showing that the mainspring is fully wound), but the balance wheel oscillates back and forth for a brief period when gently handled, it's probable that the watch merely needs to be dismantled and repaired.

A watch is a compact, sophisticated mechanical device composed of interlocking elements that must be lubricated to work correctly. As the watch functions, dirt and dust gather inside the mechanism, ultimately blocking the bearings and jewels. This slow accumulation of friction makes the gears increasingly difficult to move until one day, especially if the clock has been neglected for an extended time, you realize that it no longer functions even when wound.

You can immediately ask your watch repair technician for help when this happens. Observe as he disassembles your watch, cleans it, and then lubricates every bearing and jewel with small drops of special oil. Then, seemingly out of nowhere, your old watch that had ceased ticking and tocking will begin to tick and tock anew.

Regulation and Shock-Absorbing

A golden frame with a red gemstone can be observed on the upper side of a modern balancing wheel system (it is an artificial ruby called cap jewel). That frame, available in various forms, serves as a shock absorber (one of the most famous is the so-called Incabloc). Because the Incabloc was invented in 1935, its existence or absence might help you determine the age of a watch. If it's there, it'll be there from then on. If it isn't, the movement is either exceedingly rudimentary or pre-historic. The balancing wheel's design can also disclose the age and quality of a movement. To fine-tune the oscillations of the best balance wheels in earlier movements, a set of small screws positioned radially on the balance wheel surface were utilized.

The existence of those small screws was a mark of quality in old movements. So much so that the balance wheels of certain low-end timepieces were embellished with small, phony screws! Because of the development of materials used in various sections of watches, this micrometric control is no longer necessary in modern clocks. The regulating device is adjusted correctly with each modification. Many of these balance wheel components are fashioned like a longish lever that may be used to adjust the watch by pointing it on a scale. The amplitude of the balancing spring is changed by this little adjustment, causing the entire balance wheel to beat faster or slower. This is the primary approach for fine-tuning the performance of your mechanical watch.

Watch Servicing

The first step is to take the watch apart. Disassembling the movement entails removing it from the case, removing the dial and hands, and working on the movement itself. A mechanical movement comprises several levers and gears (called "wheels") sandwiched between two or more metal plates. The largest is known as the "main plate," while the others are known as "bridges."

A central shaft with two small pinions between the main plate and the bridge powers the wheels (s). They enter what is called "jewels" in high-quality movements. Typically, each wheel has two jewels, one up and one down. Aside from these components, watches contain a variety of springs. The "mainspring" (which is wound to supply power to the watch) and the balance spring, which are installed on the balance wheel to cause it to oscillate back and forth, are the most important.

Other pieces are added to the basic mechanism when the watch has extra functions. Every function of a watch is known as a "complication," and it requires the usage of extra components specialized to carry out that function. A function might be the date, the chronograph, or the lunar calendar. Anything goes from every day to the fantastic.

The watchmaker disassembles it by removing the tiny screws that hold all of this delicate design together, then cleans each component with an ultrasonic machine — or other liquids if traces of rust need to be removed. Watchmakers use ultrasonic cleaning machines similar to those used at home to clean jewelry, glasses, and other items. The tiny pieces are placed in metal containers and ultrasonically cleaned until they are new.

The watchmaker meticulously inspects each jewel after cleaning every portion of the watch to verify that it is in excellent operating condition. Suppose he sees anything out of the ordinary, such as an ovalized hole in a jewel. In that case, it indicates that the watch has a problem, which might be significant and demand more costly repairs (like substituting the jewel or finding a spare part to replace the faulty one). If everything checks up, he reassembles the watch piece by piece, lubricating the mechanism with special mineral oil. The

mainspring is also unraveled, dismantled, cleaned, and then coiled back into the barrel and lubricated to work well. After reassembling the movement, he checks its performance with a timegrapher. He adjusts it until it is as near to perfect timekeeping as feasible – subject, of course, to the performance of the movement itself since specific movements are naturally better than others. The "engine" is now operational.

Let's take a look at the rest of the watch. The dial receives the same treatment: it is ultrasonically cleaned (if possible; some older dials cannot be cleaned in this manner) and evaluated to determine whether any repairs are required (unless it is in bad shape, it is much better not to). The watchmaker will then coat the dial with a thin layer of special wax to protect it from dust and filth while also shining it.

After being reviewed and straightened, the watch hands are cleaned and replaced. Touch-ups are done as needed if any lume remains on the dial or in the hands. Both the casing and the glass are treated in the same manner. If the glass is substantially scratched, especially if it is plastic, it is replaced (very common in vintage watches). This becomes more complicated and costly if the glass is mineral or sapphire crystal. When feasible, the watchmaker will polish it to eliminate minor scratches and enhance the visibility of the dial.

The watch casing is in the same predicament. Good watchmakers usually avoid heavy interventions on historic watch cases since they remove part of the case's metal and may cause the watch to lose its characteristics and character. Furthermore, in numerous vintage watches from the past century, a thin layer of gold or chromium was placed over a metal casing (typically brass), which might end up cracking and flaking away if given a deep cleaning! The only way to ensure the watch is worn again if the surface is significantly damaged and chipped is to re-plate it. This approach would make the watch more attractive.

Still, it would also make it appear false — so continue carefully if you must, as recent restoration theories encourage cautious conservation over comprehensive refurbishing. If the watch has a bracelet, it is also ultrasonically cleaned and softly polished; alternatively, if the watch has an old wristband, it may be replaced with a new one, with the

original clasp removed and re-used. All of this, as you would think, comes at a cost. A simple servicing like this for a conventional watch would cost roughly $100-$150 in the Western world, plus any extra interventions or components needed, such as a new glass or strap or even the purchase of spare parts if something was damaged. Keep in mind that the more complicated the watch, the more parts the watchmaker will have to remove, increasing the cost of watch repair and service. For example, because a chronograph watch contains 50% more components than a conventional timepiece, service on a chronograph watch is likely to be 50% more expensive.

The design of a mechanical watch mechanism demands frequent maintenance, which includes lubrication to prevent friction on moving components, which wears them out. Over 50 locations of friction in a standard wristwatch must be oiled, and the more complexity of the watch, the more spots that must be oiled. Like any mechanical engine, automatic and manual mechanical watches require maintenance, cleaning, and a complete oil change, or "overhaul," as watchmakers refer to it.

NOTE: The oils described in this book are only a few of the "approved" watch maintenance standards today. As oil technology evolves, what is advised now may not be recommended tomorrow.

If your watch begins to run slowly and loses accuracy, it must be oiled. When the oil evaporates, the pieces scrape against one another, shearing the metal and accumulating dirt. When you open the watch, you'll notice that the diamonds are dry or crusty with old oil and grime, and the metal plates and gears are worn.

Oiling is typically performed at regular service intervals, but if you have acquired a vintage watch, it will almost surely require oiling since the oil has dried or gummed up. If you are unclear about when the previous service was performed, it is preferable to refurbish the watch. The watch must be thoroughly dismantled, cleaned, and re-oiled according to the manufacturer's recommendations for best operation.

If you want to operate your watch again, simple oiling of the jewels and escapement will suffice - but don't expect it to be as good as new. If all you want is for the watch to maintain time, you might not mind

if the extra capabilities, such as the day/date, timer, and other chronograph features, quit working (and they might not, without a proper cleaning) oiling service). Although disassembling your watch to clean and re-oil may not appeal to you, the work is worth it. The bulk of the parts are easily accessible; however, significant disassembly is necessary to reach sections that need to be oiled but are not accessible from the surface of the watch mechanism.

For best performance and accuracy, manufacturers recommend that the movement be removed, cleaned, dried, assembled, and lubricated to specification. Oiling a filthy watch retains dirt and debris, allowing the oil to spread throughout the movement and the watch to function poorly. Synthetic oil, which does not gum up like natural oils, is currently used to lubricate most watches. When synthetic oil has served its purpose, it will simply evaporate.

Oiling Guidelines

When oiling a watch, take care not to over-or under-oil it since this might cause further issues. The technical paperwork for your watch movement is generally available online, and it will tell you where to oil it, what sort of lubricant to use, and how much oil to use. Use your best judgment to apply just enough to cover the surface, but not so much that it runs off the component. If you apply too much, it may seep into places you don't want, producing problems.

Epilame is a substance that might assist you in keeping the oil in the desired location. It's commonly found in high-speed regions such as the escape wheel and pallet for jewels, as well as the balancing cap jewels. For simple oiling, you'll need an oil applicator, an oil cup or well, and the oil itself. Since they are cheap and easy to use, dip oilers are the most common oil applicator. They come in many sizes and are color-coded for easy identification.

Simply dip the tip of the oiler into the oil and pick up a drop before applying it to the oiled area. Capillary action then draws the oil onto the watch component. To shape the tips of dip oilers to your satisfaction, use sandpaper. Because they enable more exact oiling, automatic oilers are frequently advised for Rolex watches. With the stroke of a button, these oilers can place a minute particle of oil exactly where you want it.

Oil cups are exactly what their name suggests: oil reservoirs. Because using oil directly from the jar can contaminate the remainder of your supply, use oil cups with lids to use only a tiny quantity of oil while keeping it clean. Keep the lid closed when not in use to keep dust and grime out, and always dip the oiler nib into the edge of the cup rather than the center. If there are impurities in the oil, they will settle in the middle of the cup. When taking up oil, don't push too hard into the oil cup to risk fracturing the tip of the oiler. Ruby oil cups outperform plastic to decrease friction when picking up oil.

Between usage, clean the oiler tips with Rodico or a spongy/foam substance. Replace the oil in the cups after roughly a week, and clean the cups between usage. Check on the expiration dates of the oils because they can lose potency over time and may not last until the next service date.

Below is a list of the common oils used in mechanical watch movements.

1. The most common oil is Moebius 9010, a light synthetic oil used in high-speed, low-pressure locations such as cap jewels, train gear, pivots, pallet jewels, balancing staff, and regulating sections.
2. HP 1300 - HP1300 is a heavier synthetic oil for barrel arbors, oscillating weights, center wheels, and third

wheels (also known as Moebius 9104). This phrase is occasionally used on scheduling systems and calendars.
3. Moebius 0941 is a premium oil for pallet jewels and escapement.
4. Moebius 8200, a natural grease, is used to lubricate the mainspring.

Here are the watch components that need to be oiled and where to oil them.

1. Any jewel visible should be oiled since it is a point of friction where a wheel or gear pivot travels through it.
2. Three key components that require oil and can make your clock operate again are the escape wheel, balance staff, and pallet fork. The Balance Staff's bottom and top jewels should be oiled with a light oil such as Moebius 9010. Several surfaces should not be oiled, which might cause significant problems. It's critical not to get oil on the gears or hairspring; if you do, they'll need to be removed, cleaned, and replaced.
3. The bottom and top jewels of the escape wheel need oil with Moebius 0941. Pallet Fork requires oil at the bottom and top jewels with Moebius 0941.
4. If the mainspring requires re-oiling, clean it with one dip and then re-grease it with Moebius 8200 using a cloth to spread the grease down the length of the mainspring.
5. Oil the jewels with Oscillating Weight using the heavier Moebius HP1300.
6. Stem and Clutch. Lubricate the flat side of the stem that travels through the clutch at the end.
7. Gear Train: Use Moebius HP1300 or 9010 to oil specific gears on the ends at the jewels, such as the hour wheel internal shaft, minute wheel outer shaft, and more.

Chapter 5

Practical Clock Repairing

Because there are so many types and grades of clocks, a study of repair procedures must be very general. On the other hand, the solution should be efficient and, in our opinion, comprehensive enough to cover all common types of clocks found in most homes and businesses.

The following information concerns cleaning and oiling the famous American mantel clock with a counting wheel striking mechanism. The procedures mentioned here apply equally to cleaning French, English, and German clocks and regulator, chime, and grandfather clocks. Aside from cleaning, repairs are given significant attention in subsequent portions of this chapter.

Note: The 400-day and American alarm clocks are treated separately since they are in a class of their own.

Cleaning and Oiling the American Striking Clock

Removing the Movement

In general, removing the movement from the case is a simple task, and in most cases, it is so evident that no explanation is required.

First, remove the hands and gongs from wooden-cased American mantel clocks. Unscrew the four screws holding the movement in place and lift it out. If one of the mainsprings breaks, there is a problem. In this case, wind the good spring completely and remove the side containing the good spring first. The movement will be difficult, but avoid bending the wheels.

Dismantling the Movement

Examine the striking train before disassembling the movement to determine whether there are any markings on the wheel and pinion that conduct the locking and warning functions. If there are none, use a graver to identify the spot where the wheel gears with the pinion. If this is done, the striking mechanism may be reassembled by noting the markings, and the timing will be accurate — assuming it was proper before dismantling.

Install spring clamps over each spring before lowering the mainsprings with bench keys. When springs are purchased, new mainsprings are in clamps, and many sizes are available. These will be kept for future reference. Place the key on the winding arbor's square, release the click, and gently release the spring by slipping the wooden handle between the thumb and fingers.

After the springs have been completely let down, check the freedom of the pivots in the holes in the plates. Remove the top plate and timing train, keeping the various wheels together and taking note of the degree of wear. After that, separate the striking train and levers from the timing train. The pieces can now be examined in greater depth. Examine the pivots to see if they are worn or need to be polished. Next, examine the pallets. These are frequently in need of polishing, which can be done with a No. 0 emery stick. If the grooves are

severely worn, they should be ground out with an emery or Carborundum wheel before being polished with a strong felt buffing wheel coated with rouge.

Examine the wheels to see if they are too tight on their arbors. Escape wheel teeth that are bent are a common issue, and each tooth should be thoroughly checked. The warning wheel's locking pin is frequently found to be loose. A broken mainspring can cause fractured teeth and broken railway wheel pivots.

This chapter will go over how to fix these and other flaws in a later section. We'll start with the cleaning assuming the clock is in good working order.

Cleaning the Movement

Some cleaning solutions designed for watch cleaning machines are sufficient, as long as they can be mixed with water. Fill a large bowl halfway with the cleaning solution. Allow the plates, wheels, and other items to soak for several minutes in the solution. Brush the components thoroughly with a stiff brush. Sharpen the peg wood to a point and press it firmly into the plate holes. After rinsing in warm water, shake the pieces in warm boxwood sawdust until dry.

If you have a tiny electric heater, you may dry the pieces without the sawdust. Place the components on a big table near a heater. Before assembly, ensure all parts, especially the mainsprings, are completely dry.

Assembling the Clock

Install the lower plate on a wooden frame and the wheels in their proper positions, starting with the first wheels and springs. Start at the action's bottom and work your way up, finishing with the flywheel, escape wheel, and pallets. The tail of the striking hammer should be clear of the lifting pin. The pin on the warning wheel should be about half a turn away from the top piece of the warning lever.

Next, position the top plate and guide the center and first wheel arbors into their respective holes. With the tweezers, guide the pivots of the bigger wheels and, finally, the smaller wheels to their proper

holes. Pin or screw the top plate and test the striking and timing trains for freedom.

Wind the mainspring partially up and apply mainspring oil to the various coils. The pivots, the pallet, and every other tooth of the escape wheel should be oiled with clock oil. The crutch is lubricated, where it encircles the pendulum rod.

Fit the minute hand and test the strike. Gently turn the hand almost to the hour to see if the warning occurs correctly. The warning is given when the warning wheel is released. The fly completes one complete spin before coming to a stop. When the hand is moved to the hour, the striking begins and ends when the counting lever falls into a deep slot in the counting wheel. Test the striking for all hours from 1 to 12 and, if satisfactory, mount the movement in a wooden frame or shelf and run it through its paces. Fit the movement to the casing if it stays satisfactory after a few days of running. Set the striking hammer to strike the gong. To determine the beat, listen to the tick. Adjusting the rhythm is accomplished by bending the crutch wire so that the ticks are evenly spaced. Fit the hands and start the timer. The subsequent regulation usually takes around two weeks.

The preceding description of cleaning and setting up the clock implies that we will have no problems. Often, it is not so straightforward, and the following sections address many common repair issues encountered during clock fixing.

Clock Repairing

Mainspring Issues

Going barrels are used in higher-quality clocks to receive the mainspring. The spring is wound at the arbor in the going-barrel power unit, and the barrel bears the first wheel. Barrels containing mainsprings should always be removed for examination and cleaning. Slowly unwind the spring, allowing it to uncoil inside the palm of your hand. Set mainsprings should always be replaced with new ones, and while the mainspring winder is recommended, the spring may be wound into the barrel by hand with no perceptible distortion. After winding the spring into the barrel, apply a tiny quantity of oil to it and reinstall the cover.

Most clocks with running barrels have a riveted hook in the barrel, and the outer end of the spring has a pear-shaped hole that fits into the hook. The hook is occasionally taken out, and a new one is necessary. Broach the barrel hole to a clean, straight hole before installing a new hook. Choose a steel wire and form the hook to resemble the old one. Install the hook from the inside out. Position the interior of the barrel on an anvil in such a way that the hook is held in place, then rivet the hook in place with a round-end hammer.

The spring's pear-shaped hole frequently pulls out. If the rest of the spring is in excellent shape, a new hole, in the end, can be tedious. Remove the outside edge of the original hole and heat it until it becomes blue. To fit the hook in the barrel, drill a fresh hole and file the aperture. Finish the spring's end with a flat file, then bend the end beyond the hole to the barrel wall's curvature.

Repairing the Train

Closing Holes

Because clocks run too long between cleanings, the holes on the plates frequently become poorly worn. Because the strain on the pivot is directed away from the wheel that drives the pinion, wear commonly occurs on one side of the hole. In low-cost clocks, the hole can be filled with a hollow center punch and half of the end ground away. The metal is pushed toward the hole by fitting the punch to the side of the hole where the wear is highest and hitting the punch firmly with a hammer. The punch leaves a crescent-shaped mark on the plate, which is harmless. Some clock repairers may consider this procedure to be unsophisticated. We agree that it should not be done on high-quality clocks, but we see no reason why it shouldn't be done on lower-quality pieces. The hole should be adequately closed so that the pivot does not fall in. Broach out the pivot hole to a free fit and test the wheel between the plates for freedom.

Fitting Bushings

Bushings are used to repair damaged pivot holes in high-quality clocks. Bushings can be purchased in assortments from material merchants or fashioned from a length of brass wire. Place the wire in a lathe chuck, face it off, and turn a little center in it. Place a drill slightly smaller than the pivot in the pin vise and drill a hole 1/2 inch deep. Broach out the hole in the plate from the inside to nearly three times the diameter of the pivot. Turn the brass wire so that it just partially enters the hole. Using 4/0 emery paper, polish the graver and bright-cut the end of the brass wire. Connect an oil cup to the hole in the previously drilled wire. Now, trim the bushing to the length needed to match the thickness of the plate. Drive the completed bushing flush into the plate and broach out the hole to suit the pivot. The broach burr can be eliminated with the wheel countersinks.

Pivoting

When pivots are broken off or badly worn, the repair known as pivoting is necessary. Center the lathe chuck on the wheel. Remove the broken pivot section with the graver and turn it a little center.

Place in the pin vise a pivot drill that is somewhat bigger than the original pivot. Turpentine can be used to lubricate the drill for more successful drilling. The hole should be bored deeper than the pivot's length. Turn a piece of stiff wire or pivot wire down to fit the opening. The wire should be somewhat tapered. Draw the file carefully, and cut to length until it fits halfway to the bottom of the hole. Now flatten the finish. Insert the pivot and replace the wheel in the lathe. A couple of hammer blows will securely fix the pivot in the arbor. The pivot has been turned to size, burnished and polished, and the end has been gently rounded.

Fitting Teeth to Wheel

Broken teeth are common in clock movements, although they are easily repaired. File a slot beneath the lost tooth to a depth equal to the tooth's height. Choose a piece of brass the same thickness as the wheel and file it to fit the newly produced aperture. Insert the component and solder it in place using mild solder. Laying the wheel on a copper plate and holding it over an alcohol lamp is a practical soldering technique. Caution should be used to avoid overheating the steel pivots. A portion of an old wheel is frequently used as material to repair a damaged wheel. Following the soldering, the teeth are shaped using needle files.

Escapement Repairs

The escape wheel is frequently worn at the ends of the teeth, and deep grooves in the pallets are common. Taking the escape wheel first, the worn tips of the teeth may be restored to good condition by grinding them down. Center the escape wheel arbor in the lathe chuck and use an Arkansas slip to softly grind down the tips of the teeth while the lathe is operating at high speed. Smooth the surface even further using a steel burnisher. This procedure somewhat lowers the diameter of the escape wheel and may need to adjust the pallets to suit the wheel. An excess inside drop may occur, and the solution is to close the pallets. The pallets must be tempered to a blue hue before clamped in a vise. Make modest corrections, testing the pallets to the wheel often until the drops, both outside and inside, are equal.

After you've determined that the repair is adequate, heat the pallets to

a cherry red hue and immerse them in water to restore the original hardness. The pallets' weathered surfaces have been ground and polished.

In some circumstances, the pallets or escape wheel may be moved such that the wheel's teeth glide on an unworn area of the pallets.

Repairing the Striking Mechanism

Counting Wheel System

Incorrect timing is frequently the cause of the counting wheel mechanism failing to cease striking at the right moment. Allow the striking to run gently as the minute hand moves to the hour. The drop lever should lock in the cam wheel when the counting lever lowers into a deep slot in the counting wheel. The drop lever cannot lock into the notch if the cam wheel is not in the appropriate position. To lock the train, let the mainspring down or insert a watch screwdriver through the second wheel and plates and separate the plates on the striking side. Separate the cam wheel from the adjacent wheels and turn the cam wheel to adjust the timing. Reassemble the striking train and try once more.

Several levers must frequently be bent for the drop lever to descend the proper distance to contact the cam wheel. Of course, there are several additional causes for striking issues. In truth, most occupations will provide a slew of issues. To succeed, one needs to have a decent amount of mechanical aptitude as well as a lot of experience.

Rack and Snail System

Worn components typically cause striking mistakes in the rack and snail mechanism. The collecting pallet pivot hole must fit snugly. A huge hole at this location frequently causes the gathering pallet to hang up on the rack or fail to collect the required number of teeth.

The failure of the warning lever to descend at the hour indicates a worn stop piece on the warning lever. The worn mark is readily filed and stoned away, and the striking will resume regular operation.

The pivots that carry the rack and the snail system's various levers

should be free. This is highlighted since a wrong action can be highly perplexing, as a tight lever is not easily spotted.

Another erroneous adjustment that occurs on occasion is the raising of the striking hammer when the clock warns. This leads to a lot of pointless running once the strike is done. There should be minimal run following the hitting, and the striking hammer should not be lifted during the warning. The correct adjustment reduces the likelihood of the clock failing to strike when the oil becomes thick.

Repairing Broken Hands

Hands frequently break in the center. However, this is not a problem in the newer standard models of clocks because replacement hands can be ordered. On the other hand, hands for French and antique clocks cannot be purchased and must be fixed or custom-made. The following repair approach is suggested:

A brass collet is placed in the French clocks' middle of the hands. This collet has been extracted from the fractured piece. Choose a tiny piece of flat steel roughly the same thickness as your hand. Drill a hole in it and widen it to accommodate the collet. Shape the steel piece using a file. The thin section should be broader than the hand and roughly half as long. Fit the collet to the piece, ensuring the endpoints are toward 12 to ensure proper striking and rivet firmly. Apply a little amount of soldering flux and soft solder to the steel piece. Hold the steel piece and the broken hand together firmly with tweezers and heat over an alcohol lamp until the solder melts. Finish by filing or grinding away any excess steel. When the repaired hand is attached to the clock, it will operate as well and look as lovely as the original hand before it was broken.

400-Day Clock Repair

The 400-day clock is also known by other names, such as yearly wind clocks and anniversary clocks.

It has a balancing wheel hanging at the end of a flattened steel or phosphor bronze wire instead of a pendulum. It should be noticed that there are three intermediate wheels, as they are designed to operate a year between windings. The barrel turns once every 80 days, and the

balance vibrates eight times each minute or 7½ seconds per vibration. Some of the older models may have exceptions.

The escapement is of the same sort as the dead-beat escapement. Some are created using adjustable pallets, while others are made with one-piece pallets. The pallet pin is a circular wire about 1½ inches long that lies above the pallet frame and whose upper end freely moves between the fork F.

The suspension wire S is used to secure the fork. When an impulse is applied to the fork, the suspension wire twists, transferring force to the balance. When the wire is twisted, the balance is slightly elevated; hence, two forces are present: the twisting tension and a tiny pull of gravity.

Cleaning and oiling are similar to any other clock, but adjusting the escapement, adding new suspension wires, and regulating provide additional challenges. Assume the clock is up and operating. If the locking of the escapement is not equal, turn the block that supports the top end of the suspension wire to make it so. This component is friction-fitted onto plate P. However, inspect the suspension wire before adjusting block B for any bends or kinks around the fork.

The American Alarm Clock

Repairmen often dislike working on low-cost alarm clocks. Because of

their cheap cost, significant repairs are impractical. However, there are a few considerations to keep in mind, and in most situations, the low-cost clock may be returned to excellent working conditions with no time investment.

Dismantling the Clock

The first step is to remove the clock's time-winding and alarm-winding keys from the rear. An arrow indicates the direction the keys are turned to the wind. Turn the keys in the opposite direction to remove them, as most keys are screwed on. In a few instances, the keys are friction-fitted to a square on the arbor. Insert the jaws of cutting pliers under the keys and pry them off if this is the case. Because the apertures on the rear plate are big enough to allow the knobs to pass through, the movement may usually be removed from the case without affecting the time-setting and alarm-setting knobs. The method for removing the movement from the casing varies depending on the manufacturer of the clock. A cursory investigation should reveal this. The bezel on most alarm clocks is pulled off, and three or four screws in the rear are removed. The movement is then lifted to be examined.

Note the outer coil of the balancing spring attached to the stud. To release the spring, remove the brass wedge. Remove the balance from the movement by removing one of the threaded steel cups that hold the balance staff. Examine the balancing staff's pivots. When the pivot ends are touched with a finger, they should feel crisp. They must be sharp to the touch if they are not already. Assuming that the adjustment is required, first indicate the balance with the position of the balance spring's outer end. The balancing spring may be removed by pushing the tapered sides of the tweezers beneath the collet. Place the staff in a split chuck and sharpen the pivots using an Arkansas slip and oil. Finally, use a steel burnisher to polish the surface. Now, reverse the staff and arrange the opposite pivot similarly.

Cleaning the Clock

With the balance removed from the movement, it is time to clean but first, remove the hands and dial. Cleaning with white gasoline or benzene is sufficient. Fill the jar enough to cover the movement, then

set the movement in the jar. Allow for 10 to 15 minutes of standing time. Next, take a brush with firm bristles and, after soaking it in gasoline, thoroughly brush the movement, paying particular attention to the pivots and the perimeter of the escape wheel. The escape wheel frequently requires extra attention since the pallet pins' propensity to drive dirt into the base of the teeth. This does not apply to clocks with banking pins. However, pin pallets are rarely equipped with banking pins. As a result, dirt accumulates and reduces the angular motion of the lever, perhaps to the point of removing guard freedom. Ordinary cleaning may not remove this hardened filth, so scrape the base of the teeth using a sharp device that may be entered between the plates. Rinse the movement in the cleaning solution and let it dry on a clean sheet of paper.

Using a brush dipped in gasoline, clean the balance; rinse in warm water, dip in alcohol, and dry in warm sawdust. The balancing spring is cleaned the same way, except it cannot be brushed.

Replace the balance spring with the correct position on the balance when the pieces have dried. The previous mark on the balance indicates the correct position. Adjust the threaded steel cups to give the staff some room. Place the spring between the regulator and the wedge at the stud, observing the previously formed mark. Insert a screwdriver into the collet slot and turn the balance in the proper direction if the escapement is not perfectly in beat. When the balancing spring is at rest and the impulse pinpoints precisely toward the pallet center, the escapement is said to be in beat.

Oiling the Movement

Wind the time and alarm springs and apply clock or mainspring oil to the coils. Oil the train wheel pivots, balancing pivots, and every other escape wheel tooth, as well as the alarm pallets. The balance should now begin with a quick movement of at least one turn. If it does not, we must seek other flaws.

Adjusting the Escapement

The escapement might be an issue if the balance does not move well. Slowly turn the balance until one tooth can pass through a pallet pin. When the escape wheel turns, another tooth engages the other pallet

pin. There should be a distinct locking, but this is not always the case. Instead, we may discover a mistake in which the pallet pin fails to lock, in which case the pallet pin will engage the impulse face of the tooth. Using long, flat-nosed pliers, bend in the thin protrusion of brass into which the pallet arbor is placed toward the escape wheel. Because the opposite end normally lacks such a mechanism of adjustment, bending the pallet arbor tongue causes the pallets to be slightly out of upright. This, however, is not an issue in clocks of this caliber. The only other adjustment is to bend the lever to align the fork slot with the impulse pin.

Pallet Pin Installation

If the pallet pins get worn, they must be replaced. Remove the lever from the movement by releasing the mainspring. Because the pins are held in place by friction, all required is to put the lever on the bench block and push the pins out. Sewing needles of the appropriate diameter are ideally suited for new pins. Cut the needles to the desired length, finish the ends, and insert them into the holes. Because the needles are finely polished, no additional polishing is required.

Adjusting the Alarm

At the dial side of the movement, there is a long flat spring with a bent-over end that reaches through a hole in the plate. The bent-over end locks or unlocks a lever (locking lever), allowing the alarm to sound at the specified time. Turning the alarm setting knob reveals what happens and allows for the required adjustments. Bend the locking lever back slightly if the bent-over end does not rise high enough to release the locking lever when the alarm should sound. If the alarm keeps going off, shift it forward.

Hand Replacement

Slowly turn the alarm setting knob and stop when the clock alarms. Set the alarm indicator hand to noon Place the hour and minute hands at 12 o'clock. Next, clockwise turn the time setting knob forward and check the time when the clock alarms. If the alarm does not sound at 12 o'clock, reposition the hands until the clock alarms at the correct time.

When the clock is set to time, the alarm setting knob and hand sometimes turn. This should not happen because it implies a lack of friction in the alarm-setting mechanism. Many clocks feature a nut that may be tightened to fix the problem. In certain circumstances, removing the alarm setting knob is required to modify.

Chapter 6

FAQ

Q1. Is it possible for body chemistry to halt a watch?

Yes. Watches might cease operating due to a person's body chemistry, particularly his acidity level. It differs from person to person, and these variables considerably influence everyday operations.

Q2. My watch always stops at midnight.

The watch most likely stopped due to a malfunction with the calendar trip mechanism. You should bring it in for repairs.

Q3. My watch was dropped and now does not work.

Dropping a watch might cause a wheel or axle to break; frequently, the balancing staff (which generates the ticking noise) breaks and must be replaced.

Q4. My watch was working fine for a while, but it's now slowing down and stopping.

Like any other equipment, it requires lubrication to operate correctly and should be re-lubricated every 3-5 years.

Q5. My watch works very fast.

The fluid that lubricates the watch's internal parts may shift over time, causing parts that shouldn't stick to stick, such as the mainspring. It could also be the result of the watch being dropped and the hairspring becoming out of alignment or the watch becoming magnetized.

Q6. My automatic watch runs slowly when I put it on.

That is because the watch must be wound, either manually or by an automatic winding mechanism that utilizes your wrist motion to wind the watch. If the watch is completely wound but still runs slowly, it simply needs maintenance from a watchmaker every 4-5 years.

Q7. When I wind my watch, it never stops winding.

A hand-wound movement signifies that the mainspring has broken and must be replaced.

Q8. The crystal on my watch is fogging up, and I can't see the dial.

The watch's water-resistant gaskets may need to be replaced. Water could have gotten into the case if the crown had not been pressed back in, causing fogginess. Water may have harmed certain internal components of the watch, so it must be serviced as soon as possible.

Q9. The calendar changes at noon.

When this happens, change the time by 12 hours to manually reset the watch.

Q10. The chronographs second-hand do not return to "0."

A simple resetting of the Chrono hands will occasionally solve the problem. Mechanical watches with chronographs require adjustments

over time, and periodic maintenance is due.

Q11. My watch operates when I don't wear it, but it stops when I do.

Because the circuits in quartz watches may be faulty, this is a common occurrence. The circuit may develop poor contacts or faults as time and temperature change (such as when the watch is worn). When you remove the watch and resume normal performance, it cools down. Bring in the watch for an inspection, and they should repair the circuit and perform routine maintenance.

Q12. What is the life of a battery?

A watch's battery should last 1-2 years, depending on how many complications/functions it has (for example, alarms, stopwatch, etc.) and how old it is.

Q13. Is it possible for the human body to deplete a battery?

Yes, your body's excessive electric levels are to blame. Others will not outlive a man with an average current level on his body. Your battery will not last two days if you have a lot of power.